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No. XV.

Memoir on the Analysis of Black Vomit. By Dr. ISAAC CATHRALL.

Read June
20th, 1800.

THE investigation of the properties of secreted fluids has long engaged the attention of the physiologist and chemist: but, their enquiries have generally been directed to a knowledge of those fluids in a healthy state, while little notice has been taken of the secretions of some of the most important viscera after a state of disease. The cause of this deficiency, in the examination of morbid secretions, and particularly in that denominated the black vomit, must be ascribed to the danger supposed to attend such an undertaking; though most observers must have been struck with the singular appearance of this discharge, and much astonished with the speedy dissolution that ensued; yet, none that I have had an opportunity of consulting, have attempted an analysis of this fluid. When I first contemplated an examination of the black vomit, in 1793 and 1794, I considered it as an hazardous undertaking, and limited my views merely to distinguish that fluid from putrid bile; but, after subjecting it to many experiments, and finding that it had no effect on my health, I have been enabled to advance one step farther in the enquiry; and, I have now the satisfaction of submitting to the Philosophical Society, an analysis of that fluid, together with its effects, when applied to the healthy system.

Description of the Black Vomit.

The black matter, or vomit, so called, appears to be of two kinds. One, consisting of a number of black flaky

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particles,

particles, resembling the grounds of coffee. The other, of a dark-coloured inspissated mucus: of each of these, I shall give a separate description.

This flaky discharge was always preceded by violent sickness and vomiting; and, as a precursor to the ejection of this matter, in some cases, the patients vomited a fluid like whey, or muddy water, or one consisting of a brown flaky substance, resembling chocolate, or spoiled porter, mixed with brownish-coloured mucus.* These substances were sometimes of a lighter colour, and were suspended in a glarey yellow-coloured fluid, which became nearly transparent when at rest, by the subsiding of a small number of brown particles. This coloured matter was generally vomited in small quantities, and with considerable difficulty; but, when the black flaky discharge commenced, it was frequently ejected in large quantities, and with similar force to a fluid from the action of an emetic. As the disease advances, this matter assumes a darker colour, and its quantity sometimes becomes so much augmented, that I have known one gallon vomited in 48 hours, besides a considerable quantity, which was of a much thicker consistence, that was discharged by the bowels. This black vomit, after standing some hours, deposits a black flaky substance, from a glarey yellow-coloured fluid, similar, in appearance, to an infusion of green tea. These depositions were sometimes in distinct particles, but, frequently, in a kind of dark powder. The above particles were various in size, and of a very irregular figure, not unfrequently mixed with pieces of the villous coat of the stomach. These may be distinguished by their being longer in subsiding

* The chocolate, or coffee sickness, or the black sickness, says Dr. de Monchy, is not taken from the blackish hue or shade of the skin, but it is derived from the fetid, blackish matter discharged from the first passages.

See Diseases in Voyages to the West-Indies.

siding to the bottom of the vessel, than the flaky substance. There were some disproportions between the yellow-coloured fluid, and the quantity of flaky substance, as in the other appearance of the vomit. The flaky matter was very readily re-incorporated with the yellow-coloured fluid, by the least agitation of the vessel; and, when kept in a phial, corked for eight or ten days, assumed rather an agreeable saccharine odour, and was extremely brisk, like fermenting beer. This last property is not peculiar to this fluid, but common to some other animal secretions. When the black vomit was kept for two years in a state of rest, the flaky particles became perfectly separated. On agitating the vessel, the former was immediately incorporated with the latter; and, after remaining at rest six months, showed scarce any disposition to separate. This was the appearance, if I recollect, accurately, of the black vomit, exhibited by Dr. Monro, of Edinburgh, to his class, in 1792; and which had been sent to him from the West-Indies: yet, as the professor did not permit it to go out of his hand, I cannot speak correctly as to the fact; but, believe it was not separated, and consisted of a turbid black-coloured fluid.

The mucus-matter which was sometimes vomited in the yellow fever, and particularly in that which appeared in 1797, was very ropy, and of a black colour. This matter floated on a fluid of a dark colour, which appeared to receive its tinge from the colouring-matter of the mucus. When this matter was agitated in a phial, the mucus showed no disposition to mix with the fluid-part of the vomit, and, when it was repeatedly washed, in clear water, became nearly of the colour of the mucus secreted in the alimentary canal. This black matter was discharged in large quantities, in the cases which proved mortal in 1797, and was a very in-

active fluid when applied to the most sensible parts of the healthy body, and was essentially different from the coffee-ground vomit.

Analysis of fluids, ejected a few hours before the commencement of black vomiting.

The fluids, on which the subsequent experiments were made, were obtained from three patients, from one to sixteen hours previous to the vomiting of the brown-coloured matter, which has been described as generally preceding the black discharge. In all of these cases, the sick refused every other drink but plain water. Notwithstanding the simplicity of the drink, the fluids, which are the subject of investigation, were of the following colours: The first had nearly the appearance of whey; the second was of a yellowish colour, occasioned by the mucus it contained. The third appeared like muddy water, or resembled water that had been coloured by ashes. These fluids had a disagreeable saccharine taste, and emitted an odour analogous to that arising from fluids which had been ejected from debilitated stomachs, after paroxysms of indigestion. They underwent but little change after remaining at rest for twenty-four hours, except that some part of the mucus-matter assumed a white aspect, and subsided to the bottom of the vessel.

- (a) These fluids changed the infusion of turnsole to a red colour; paper stained yellow with turmeric remained unaltered, but, when previously changed by an alkali, was restored to its pristine colour.
- (b) Caloric, or diluted acids, would not coagulate this fluid.

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- (c) Lime-water produced no clouds or turbidness.
- (d) Solution of fulphate of iron, or nitrated mercury, caused no precipitation.
- (e) Muriated barytes occasioned no alteration ;
- (f) Nitrated silver produced a copious white precipitate ;
- (g) Sulphate of copper did not show the presence of ammoniac ;
- (h) Fixed alkalies occasioned no alteration ;
- (i) Oxalic acid produced no change ;
- (k) Alcohol of galls, or prussiate of pot-ash, did not produce any precipitation.
- (l) These fluids, when exposed to cold, were congealed in the temperature in which water freezes; the ice was nearly transparent, and, when rendered fluid, had the appearance of water, and tasted like that fluid after being boiled.

The above fluid, therefore, appears to contain an acid in a free state (a); but no coagulable matter (b), nor carbonic acid, in a disengaged state, or combined with alkalies or earths (c & d); the acid (a) is proved not to be the sulphuric (e). The presence of the muriatic acid is supposed, from (f); no ammoniac is contained in this fluid (g), nor earths (h), nor lime, or the salts formed of lime and acids (i); no reason to suspect metallic matter (k); but a considerable proportion of water (l).

Analysis of black vomit.

We have already observed, in the description of the black vomit, that it spontaneously separated into yellow-coloured fluid, and black flaky substance.

(No. 1.). The yellow-coloured fluid, and flaky substance being thrown on a filter of two-folds of paper, four ounces of a fluid passed through, which was similar, in appearance, to an infusion of green-tea. It was

was moderately viscid, and had a faint sweetish animal odour, and a saccharine taste, perceptibly acrid to the lips. The matter which remained on the filter, was similar, in colour and consistence, to Venice treacle. It was weakly glutinous, and had the same odour as the yellow-coloured fluid. When this substance was dry, it weighed thirty grains. It was friable, and not of so black a colour as immediately after being removed from the filter. When this matter was obtained by evaporating the black vomit over a moderate heat, it was brittle and shining, but had no peculiar taste or smell; and, when exposed to a moist atmosphere, became soft and glutinous.

(a) Eight drachms of the filtered fluid (No. 1.) was evaporated in a shallow vessel, by a gentle heat: the vapour being condensed, was found to consist of water, which tasted neither acid nor alkaline; but emitted a strong odour of the vomit. The evaporation being continued until an adhesive residuum remained of a dark colour, resembling melted sugar. This substance affected the lips in a more obviously acrid manner than the fluid did previous to the evaporation. It was highly inflammable when dried, but not entirely soluble in water.

(b) Six drachms of the filtered fluid (No. 1.) and as many of water, were exposed in separate phials, closely corked, to an atmosphere, when the mercury, in the thermometer, was as low as 25° . The filtered fluid congealed as soon as the water. The two different fluids were examined, after standing a whole night; when the phial, containing the coloured fluid, was found entire, and its contents not quite frozen; as, a part of the fluid, on placing the phial on its side, flowed among the ice. The water, in the other phial, was completely frozen, and the vessel broken in pieces. The ice, in the

the former phial, was of a yellow-colour: The colouring-matter of which could be so much disengaged, by washing it with water, as to give it the usual transparency of ice. The aqueous part of the vomit, obtained in this manner, dissolved soap, with facility, but had not the odour of the vomit. This fluid was neither acid nor alkaline. Prussiate of pot-ash, or oxalic acid, did not cause any precipitation.

(c) Some alcohol was poured on the adhesive residuum (a), and a considerable portion of it was dissolved, which tinged the menstruum of a yellowish-colour, and gave to it the perceptible taste of the yellow-coloured fluid. A part of the residuum remained insoluble, which appeared to be of a mucilaginous nature. The menstruum was poured off, and, by the affusion of distilled water, the fluid became milky, and a resinous substance, of a yellowish-colour, was precipitated, that had an odour similar to the yellow-coloured fluid.

(d) The filtered fluid (No. 1.) betrayed the presence of an acid to the infusion of turnsole, as the mixture became manifestly reddened. 2. Lime-water, when added to a portion of this fluid, occasioned no change: 3. Solution of sulphate of iron caused no precipitation, nor did nitrated mercury, or muriated barytes.

(e) To some of the filtered fluid, I added nitrated silver, and a copious white-coloured precipitate was formed. Four drachms of the above fluid was evaporated over a moderate fire, until it was reduced to about one drachm; when suffered to remain at rest, in a cool place, crystals, of a cubic figure, were formed. These decrepitated upon coals, and had all the characters of muriate of soda, or common salt.

(f) To separate portions of the filtered fluid (No. 1.) was added oxalic acid, prussiate of pot-ash, infusion of galls, and a solution of sulphate of copper; but neither of them produced any precipitation.

(g)

(g) Some distilled water being digested on ten grains of black flaky substance (No. 1.) for twelve days, after which it was gently heated and committed to the filter.

1. This liquor immediately changed the vegetable blue to a red colour. 2. Lime-water caused no precipitation. 3. Muriated barytes effected no change; but, on the addition of nitrated silver, a white-coloured precipitate was produced. Some of the above fluid being cautiously evaporated to a certain quantity, on cooling, crystals of a cubic figure were formed. These had the properties of muriate of soda, or common salt.

(b) Some marine acid, a little diluted, was poured on ten grains of the black flaky substance, (No. 1.) a slight coagulation was produced, after standing twelve days. The mixture was filtered, and divided into four portions.

The first portion was saturated with lixivium of mild pot-ash, but no precipitation ensued; yet, in a few hours, a saline substance appeared at the bottom of the vessel.

To the second portion was added sulphuric acid. This threw down a copious flocculated precipitate, of a white colour, which I supposed to be lime; but, on pouring off the fluid, a thin layer, of a white, fatty substance, was spread over the bottom of the vessel. This had an unctuous feel, and stained paper like oil; and emitted an animal odour when thrown upon coals. This matter, when kept in a phial, corked for two weeks, assumed a yellow-colour, and had an odour like rancid spermaceti.

To the third portion, prussiate of pot-ash was added, and Prussian blue produced.

To the fourth portion, alcohol of galls was added, and the mixture saturated with lixivium of mild pot-ash, which immediately struck a black colour.

(i) One hundred and twenty grains of the nitric, and as many of sulphuric acids, were digested on ten grains of dry black flaky substance (No. 1.) placed in different vessels, for twelve days. At the expiration of that time, the black substance was entirely converted, without the application of heat, into the fatty matter before mentioned. That on which the nitric acid was used, was of a yellowish colour; the acid appearing to have undergone no perceptible change. But the sulphuric had assumed a black colour, and the matter that had precipitated, was as white as snow. This, in both acids, rose to the surface, and assumed the appearance already described.

(k) Some distilled water was boiled on the unctuous matter (i). This liquor was filtered; but, on the addition of oxalic acid, no precipitation ensued.

(l) Two ounces and a half of black vomit was put into a retort, adapted to a receiver. This was placed in a water bath. Soon after, the fluid began to boil. Two drachms of a brownish white-coloured fluid, having a small quantity of oil on its surface, passed into the receiver. This had a strong odour of ammoniac and an oily, disagreeable taste. Finding that no more fluid would come over, the retort was placed in a sand-bath, and a considerable quantity of a similar coloured fluid was obtained. The residuum, in the retort, consisted of a dark-coloured spongy coal. This, when exposed, a short time, in a red hot crucible, gradually assumed a grey colour, and, at length, was reduced to ashes.*

(m) Some distilled water was suffered to stand ten days on fifteen grains of ashes (l), after which it was gently heated and filtered. This liquor did not change the colour

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* Many of the preceding experiments, were made in the presence of a medical gentleman of respectability, viz. Dr. Samuel Duffield, consulting physician to the port of Philadelphia.

lour of paper stained yellow with turmeric. Muriated barytes produced no alteration ; but nitrated silver caused a copious white precipitate. On the ashes, which remained undissolved, two drachms of nitric acid a little diluted, were digested. This mixture being filtered, was divided into two equal parts. To the first portion, prussiate of pot-ash was added, which immediately struck a blue colour, and Prussian-blue was produced. To the second portion, lixivium of mild pot-ash was added, and a copious precipitate was formed. This, when collected and dried, had the appearance of lime, and was almost entirely soluble in distilled water. This fluid, when filtered, and oxalic acid added to it, caused a copious white sediment. That this precipitate was lime, was, in some measure, confirmed, by adding diluted sulphuric acid to it, with which it formed a substance like felenite, or fulphate of lime. I found, that, by re-dissolving this precipitate in sulphuric acid, and precipitating it again with an alkali, and treating it in the manner mentioned, it gave stronger proofs with oxalic acid of the presence of lime. On the remaining ashes, which was not dissolved by the nitric acid, I digested sulphuric acid a little diluted ; after which it was boiled on them, notwithstanding there remained a fixed residue. This mixture, when filtered, showed the presence of lime and iron to chemical tests.

(n) Three ounces of black vomit were put into a retort, and the pneumatic apparatus being affixed, the retort was placed in a sand-bath, which was gently heated, after exhausting the air in the neck of the retort. The first measure of air that was obtained, did not appear to burn when a lighted taper was presented to it. The second measure of air was incorporated with water, and some iron-filings inserted in the phial, which was suffered to remain for 24 hours. This mixture

was

was found to precipitate lime from lime-water. Alcohol of galls produced a violet tinge. The vomit which remained in the retort, after the air had been extracted, from being of a very black colour, was changed, by the application of heat, to a light brown.

From reviewing the preceding analysis, the black vomit appears to be composed of the following ingredients :

(*a* & *b*) Prove it to contain a considerable proportion of water ;

(*c*) A resinous and mucilaginous substance ;

(*d*) Proves a predominant acid which is not the carbonic, phosphoric, or sulphuric acids ; but, in all probability, an acid analogous to the one contained in the fluids, ejected previous to the commencement of black vomiting. In repeating this experiment, on the same coloured fluid, taken from twenty different patients, during several seasons of the prevailing yellow-fever, I always found a similar acid to predominate. May not the incessant vomiting and the ejection of black matter, itself, which has been said to be stopped by the exhibition of lixivium of mild pot-ash, or lime-water, accomplish that end, by combining with this acid, and forming a substance less irritating to the stomach, than the acid in an uncombined state ?

(*e*) That it contains muriate of soda, or common salt ;

(*f*) Proves it to contain neither lime, metallic matter, nor ammoniac.

(*g*) Proves the black flaky substance (No. 1.) to contain an acid, in a disengaged state, probably analogous to the one predominant in the filtered fluid. This experiment likewise shows it to contain muriate of soda, or common salt.

(*b* & *i*) Prove an unctuous animal substance, and a considerable quantity of iron. The former resembled in some respects, spermaceti. How far this substance is

analogous to that analysed by the masterly talents of Fourcroy, I cannot determine; as I had not a sufficient quantity of it, to enable me to endeavour to imitate his analysis. From the black flaky substance being entirely converted into the fatty matter (*i*), it is probable that it resembles the fatty substance, described by Dr. Gibbs :*

(*k*) Shows the unctuous substance to contain no lime:

(*l*) The black vomit yielded, on distillation, a brownish white-coloured fluid, and a quantity of dark-coloured oily matter.

(*m*) The carbonaceous matter (*l*) appeared to contain muriatic acid in a combined state; likewise lime and iron:

(*n*) Proves carbonic acid gas.†

The proportion of the different substances which constitute the black vomit, I had not an opportunity of estimating, as I could not obtain a sufficient number of grains, of the black flaky matter, to subject it to a more regular analysis.

Experiments to ascertain the effects of black vomit on the living system.

From the internal surface of the stomach and intestinal canal appearing, on dissection, inflamed and sphacelated, particularly in some patients who had vomited black, it has been believed that the black vomit was corrosive, and had

* See Transactions of the Royal Society of London, for 1794.

† When the foregoing experiments were committed to paper, and during the period of the late yellow-fever, I submitted them to the perusal of Dr. Adam Seybert, whose chemical accuracy is well known to this Society. This gentleman obligingly favored me with his company on the 22d of November, when most of the experiments were shown to him, made on the black vomit, reserved for that purpose, and the result nearly corresponded with what has been already described.

had a power of acting on parts it came in contact with.* This power has likewise been inferred from some patients complaining of a forenefs in their throats, immediately after the ejection of this black matter.

To determine how far it was capable of acting on the healthy body, it was submitted to the following experiments :

1st. In October, 1794, immediately after a quantity of black vomit was taken out of the stomach, after death, I applied some of it to my tongue and lips ; to the latter it gave, a short time after application, the sensation of a fluid perceptibly acrid. This experiment was, the next day, several times repeated, with the same result.

2d. A friend of mine applied it to his lips, and it produced a similar sensation ; but would not affect his tongue.

3d. Finding the effects of this matter so different from what was expected, I began to believe that this discharge varied materially in point of activity, in different patients ; but, on subjecting the black vomit, procured from a number of persons, to the same test, it produced the same effect.

4th. Two ounces of a fluid, resembling chocolate, was obtained, which was vomited a few hours before death. This was applied in the same manner ; but, there could not be perceived any difference in the result.

5th. In the beginning of October, 1799, Mr. Joseph Parker, an active and intrepid member of the board of health, obligingly presented me with five ounces of black vomit, obtained from the physicians of the City-Hospital. Some of this I applied to my tongue, in his presence, but could not perceive the least corrosive effect. When this fluid was applied to the skin on different parts of the body, it produced no other effect, than what water did of the

* See Desportes, on diseases of St. Domingo, p. 203, vol. 1.

the same temperature. I have often immersed my hand in black vomit, immediately after it was discharged from the stomach, and whilst it was warm, without exciting the least uneasy sensation in the skin.

(a) October 4th, 1799, three cats were confined in a room, and fed with beef, which had a considerable quantity of the flaky substance of the vomit inserted into it. This manner of feeding was continued until they had eaten one drachm and a half of the flaky substance, and had drank several ounces of the black vomit. On the 5th, the excretions of the bowels were of a dark colour; yet there could not be discovered any difference in their health; but, from their being strangers to each other, they had a constant propensity to combat. This malicious spirit continued until the 20th, when they were dismissed in good health.

(b) A large dog was confined in a room, and, by an assistant, his jaws were forced asunder, and he was compelled to swallow an half pint of black vomit. The following day, the excretions by the bowels were fluid and of a black colour; but there could not be observed the least alteration in his health, from the time of making the experiment, until he was dismissed; which was about three weeks after.

(c) Two full-grown fowls were confined, and fed with bread, steeped in black vomit for twelve days. This, Mr. Parker, as well as myself, observed, they ate with great avidity; but it had no evident bad effect upon their health; for they continued as well after as they were before the experiment, and seemed to [give the preference to that kind of food] to every other which was presented to them, and they appeared to thrive equally as well as if they had been fed upon corn.

(d) On the 3d of October, 1799, in a small yard adjoining the house in which I live, several ounces of the
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black vomit, recently obtained, were evaporated over a moderate heat, in order to obtain the flaky substance. During this experiment, Mr. Parker held his head over the vessel for some minutes, so as to inhale the steam of black vomit; after which, we continued within two yards of the vessel, without experiencing any unpleasant effect.

(e) The following day, I caused the windows and doors of a room to be closed, and the same experiment was repeated on a sand-bath, constructed in the middle of a room. The fluid was evaporated until the atmosphere was so impregnated with the effluvia of the vomit, as to render the apartment extremely unpleasant, not only from the odour of the vomit, but the warmth of the room. In this atmosphere, I remained one hour; during which, I had a constant propensity to cough, and had, at times, nausea and inclination to vomit; but, after walking out in the air, these effects gradually subsided. I experienced, however, a sense of weariness at my chest for many hours after.

From the above experiments, it appears that the black vomit, when applied to the most sensible parts of the body, produced little or no effect.

Secondly, It appears that large quantities of this fluid, may pass through the stomach and bowels of quadrupeds and other animals, without apparently disturbing digestion, or affecting their health. This fact incontestibly proves the inactivity of this fluid; and renders it probable, that the speedy death which ensues, after this discharge in yellow-fever, is not from the destructive effects of this matter on the stomach and bowels; but, most likely from the great degree of direct or indirect debility, which had been previously induced, on which the black vomit is sometimes an attendant, and strongly expresses the great danger to be apprehended from the enervated state of the system.

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Lastly, The experiments (*d* & *e*) tend, in some measure to prove, that an atmosphere highly impregnated with the odour of black vomit recently obtained, would not produce fever, apparently under the most favourable circumstances.

Of the opinions of authors concerning the black vomit.

The opinions of authors concerning the properties of the black vomit, from the days of Hippocrates, until the present period, may be reduced to four heads. First, that it consisted of putrid bile. Secondly, that it was putrid blood, or, according to some writers, a mixture of blood and bile. Thirdly, that it was the villous coat of the stomach in a state of dissolution, produced by inflammation, terminating in mortification. Fourthly, it is conjectured to be bile changed to a black colour, in consequence of meeting with the septic acid, which is supposed, by professor Mitchell, of New-York, to be generated in the stomach and intestinal canal. The first of these opinions, viz. that the black vomit is putrid bile, I believe has been adopted merely from its being found, on dissection, in the gall-bladder; for their properties are very dissimilar. The black flaky substance, which is the only part of the vomit bearing the least analogy to bile, is generally of a darker colour, of a thicker consistence, and is composed of a number of flaky particles. This fluid gives a black or brown tinge to linen; whereas, bile, even after becoming highly putrid, and after being retained in vessels for months, and even years, imparts a yellow colour to water and linen, and has an intensely bitter taste. This property and colour of bile is not destroyed by a high degree of putrefaction. The experiments made on these secreted matters, render the dissimilarity of properties still more obvious. The black flaky substance, by digestion with sulphuric acid, may be
entirely

entirely converted into the fatty matter before-mentioned : but, sulphuric acid, when digested on putrid bile, soon dissolved into a blackish green liquor. This colour was rendered more apparent by the addition of water ; and the mixture had an extremely bitter taste. When diluted acids were added to putrid bile, they afforded a much larger quantity of coagulable matter, than when mixed with the flaky substance of the vomit. Moreover, these fluids differ, in their specific gravity ; for, that of the black vomit, compared with distilled water, is as 1 is to 1.025, whereas, that of putrid bile is as 1 is to 0.125.

These essential differences make it evident, that the black flaky substance is not bile of any description, or it should possess some of the distinguishing properties of that fluid.

The second opinion is, that the black vomit consists of putrid blood. With respect to this opinion, similar objections may be made, to what we have already advanced, against its being putrid bile. Blood, after becoming highly putrid, and kept for six months, will impart a red colour to water. This property, like that in bile, is not destroyed by an high degree of putrefaction. Blood farther differs from black vomit, in not consisting of flaky particles, likewise by showing no proof of containing an acid in a disengaged state. It farther differs from black flaky substance, in not being converted into the fatty matter, by digestion with the mineral acids. And, likewise, in its specific gravity ; for, that of the black vomit, compared with distilled water, is as 1 is to 1.025, whereas, that of putrid blood is as 1 is to 0.417.

Viewing putrid blood in its simple state, it certainly bears but little analogy to the flaky matter of the vomit, either in colour, odour or taste ; but, when it is combined with the muriatic, nitric, or sulphuric acids, and the mixture diluted with an infusion of green tea, it resembles, in

many respects, the black vomit. The odour, arising from this combination, so much resembles that arising from black vomit, which had been kept for several years, that I could hardly distinguish one from the other. The close analogy of this compound to black vomit, would incline one to believe, that the latter was nothing more than blood combined with a diluted mineral acid; but, as the presence of these acids, in the black vomit, in a disengaged state, could not be detected by the best tests that we are acquainted with, and, as it is not probable that they are secreted by the liver, which we shall shortly endeavour to prove is the viscus that secretes the colouring-matter of the vomit, this idea of its formation, must, of course, fall to the ground.

The black vomit has been said to consist of a mixture of putrid blood and bile. Equal quantities of these fluids, when suffered to become putrid, in a combined state, had a strong, bitter taste, imparted a red tinge to water, and, in other properties, had not the least resemblance to the black flaky substance of the vomit.

With respect to the third opinion, viz. that the black vomit consists of the villous coat of the stomach, in a state of dissolution, produced in consequence of inflammation, terminating in mortification: That black vomiting may be induced by gangrenous termination of inflammation, few will be disposed to deny; but, that the black vomit, in yellow-fever, and that from mortification of the stomach, are the same, the result of almost every dissection must oppose. The former of these substances appears to come from the liver, while the latter consists, principally, and particularly its flaky portion, of the villous coat of the stomach. Besides, the black vomit is frequently thrown up in large quantities, when the stomach, after death, has not been found much inflamed or sphacelated. In these cases, it certainly could not consist of the villous coat of the
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the stomach in a state of dissolution, but must be derived from some other source. This opinion is strongly countenanced by the dissections of Dr. Jackson, and other writers, on the subject of yellow-fever. That experienced physician remarks, that the black colour of the vomited matter was evidently owing to a mixture of vitiated bile; the passage of which might be easily traced from the gall-duct into the pylorus*. Dr. Lining, of Charleston, observes, that the black flaky substances are, the bile mixed or adhering to the mucus of the stomach; for, upon dissecting those who died of this disease, not only in this, but in former years, I always observed, says this accurate physician, that the mucus of the stomach was abraded, and the bile, in its cystis, was black, and sometimes very viscid; and, in some cases, had the consistence of Venice turpentine, and was extremely tough.† Mr. Desportes, of St. Domingo, remarks, that they found, on dissection, the gall-bladder full of black bile, the colour of strong coffee‡. This circumstance of the colouring-matter of the vomit being derived from the gall-bladder, is still farther corroborated by some dissections made by Dr. Physick and myself, at the hospital, at Bush-hill, during the prevalence of the disease in 1793. In two persons who died at an advanced period of the disease, the stomach contained, as did also the intestines, a black liquor, similar to what had been vomited, and purged, before death. This liquor appeared to be a fluid, in all respects, of the same quality with that which was found in the gall-bladder.§ These dissections, without adducing any other of a similar nature, must, no doubt, convince every impartial observer, that the black matter of the vomit is derived from the liver, and does not consist of a dissolution of the villous

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* See Treatise on the Fever of Jamaica, p. 173, and 174.

† See Observations, Physical and Literary, vol. ii.

‡ See Diseases of St. Domingo, p. 202, vol. i.

§ See a medical sketch of the Yellow-Fever, published in 1794.

coat of the stomach. The difference in the ejected matter being now established, and, in a manner, proved to be the effect of different causes, I shall proceed to consider the fourth and last opinion, viz. that the black vomit is bile, changed to a black colour by meeting with the septic acid in the stomach, and intestinal canal. The preceding dissections clearly prove this opinion to be erroneous, as they evidently show, that the black flaky particles, or colouring-matter of the vomit, come from the gall-bladder; therefore, it could not receive its brown or black colour from meeting with the septic acid, supposed to be generated in the stomach and intestinal canal.

The black vomit considered as an altered secretion from the liver.

The colouring matter of the vomit appears, from the authors already quoted, to be generally traced, after death, to the gall-bladder. This position being incontrovertibly established by dissections, the power of the liver to secrete that substance will be admitted, of course, as it could not be secreted by the gall-bladder, or transmitted into that viscus through any other passage, but by the hepatic duct. If this view of the subject be, in any measure, just, it is a fact ascertained, beyond the shadow of a doubt, that the black flaky substance of the vomit is an altered secretion from the liver. This matter, being secreted by the liver, and deposited by the hepatic duct in the gall-bladder, in the last hours of this disease, is from thence forced, by the contractions of the gall-bladder, and cystic duct, in conjunction with the violent action of vomiting into the stomach. It there receives the addition of the yellow-coloured fluid, which is almost always ejected with the flaky substance. That this fluid is combined with the flaky matter in the stomach, and not in the gall-bladder,
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every enquiry into the appearances, after death, fully confirm. This circumstance renders the yellow-coloured fluid subject to some difference in its properties, according to the nature of the fluids received into the stomach a short time before vomiting; but, all that I have had an opportunity of examining, have nearly the appearance we have already described. That the secretory œconomy of the liver may be so far arrested in its healthy action, by the progress of disease, as to assimilate a fluid having not the least analogy to bile, every work, on morbid dissections, certainly prove. Lieutaud mentions a case from Rivalerius, in consequence of a diseased liver, where the fluid, in the gall-bladder, resembled milk; and Storke relates a case of dropsy succeeding an intermitting fever, where the fluid, in the gall-bladder, resembled the white of an egg. To these, I may add one, that came under my own observation, of a gentleman who died dropsical, in consequence of an enlarged liver. The gall-bladder contained a fluid, of a dark-colour, having not the least resemblance to bile. These, and many more cases, could be adduced to prove the power of the liver, under certain circumstances, to secrete a fluid dissimilar to bile; but, it would be needless to recite them, as the instances already quoted, are, no doubt, sufficient to establish the fact. This peculiar condition of the secretory vessels, in the yellow-fever, is not confined solely to the liver; for, we find that other secretory functions are sometimes affected in a similar manner, during the same disease, and nearly at the same period of time. In confirmation of these observations, I believe most physicians must have remarked, that, in some cases, the kidneys, during the period of black vomiting, secrete a fluid of a dark-colour, which has a thick pellicle on its surface, and appears almost as different from urine, as the black vomit does from bile. This discharge is frequently a precursor to a symptom, which never fails

fails to predict a speedy dissolution, viz. a paralysis of the secretory functions of the kidneys.

The more I consider the material change produced in the different secreting vessels, during the last stage of this disease, the more this theory appears to be supported by reason and the plausibility of truth. But, though a morbid condition of the glandular œconomy of the liver may produce the coffee-ground coloured vomit, it does not seem probable that the black inspissated mucus-matter which was ejected in the cases that proved mortal in 1797, is derived from the same source; for, the liver, under no condition of diseased action, that we are acquainted with, is capable of secreting mucus of such an appearance; therefore, we think it most reasonable to refer it to the surfaces, which are destined, in a state of health, to secrete mucus. Now, admitting the axiom, "that similar causes produce similar effects, under similar circumstances," why may not the glandular structure of the stomach be affected in a similar manner to that of the liver and kidneys, so as to enable it to secrete the mucus-matter above mentioned? This opinion, I think may be affirmed by other analogies, not only in the sthenic, but in the asthenic condition of secreting surfaces, in which there are equally as great a deviation from healthy secretion as the one alluded to. This we have clearly exemplified in vessels destined to secrete mucus in a state of health; but, when labouring under inflammation, evidently secrete pus. Other cases, of a similar nature, might be adduced to prove this power in secreting vessels. But, it would be taking up the time of the society to little purpose, to recite other instances to establish a fact which appears to be already fully confirmed.

ISAAC CATHRALL.

May 23, 1800.

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